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## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

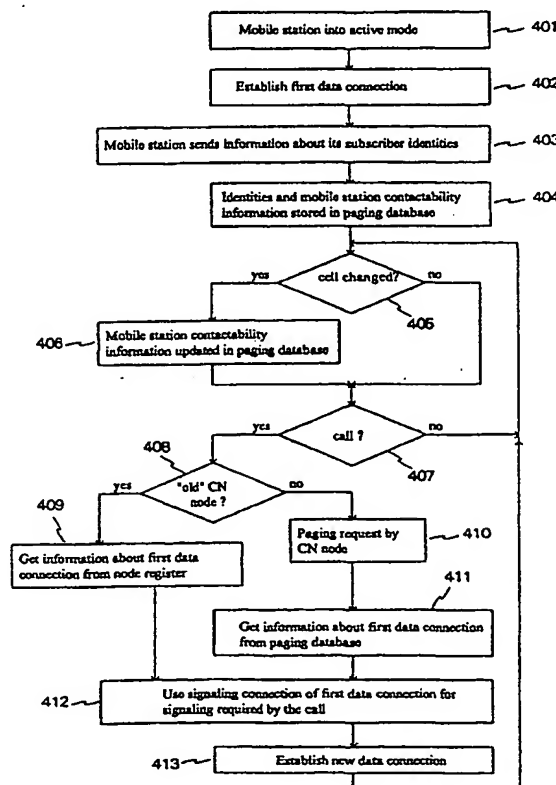
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(54) Title: METHOD FOR ESTABLISHING A SIGNALING CONNECTION WITH A MOBILE STATION

## (57) Abstract

The invention comprises a method for establishing a signaling connection with a mobile station, which method is particularly applicable to third-generation mobile communications networks. A database is created at a node of a mobile communications network, and a mobile station connected with the network sends to said database information about all its subscriber identities (403). In the database, information is added (404) to the subscriber identity information which may be useful when said mobile station is paged (410, 411). Such contactability information includes e.g. the mobile station's location information, information about existing signaling connections and information about the primary paging channel monitored by the mobile station. The contactability information is updated according to changes detected in the status of the mobile station (406). The database will be discontinued for a mobile station that has had no connections for a predetermined time. The method reduces paging channel load in cells, reduces the need of mobile stations to listen to paging channels and makes radio access networks connections to multiple core networks more practical.



EP 01 30 1345

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 9952317 A	14-10-1999	FI 980783 A	04-10-1999
		AU 3150299 A	25-10-1999
		BR 9909396 A	05-12-2000
		EP 1068758 A	17-01-2001

# INTERNATIONAL SEARCH REPORT

International application No.

PCT/FI 99/00276

## A. CLASSIFICATION OF SUBJECT MATTER

IPC6: H04Q 7/38

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: H04Q

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

WPI

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 9747095 A1 (SK TELECOM CO., LTD.), 11 December 1997 (11.12.97), page 3, line 1 - page 7, line 30	1-19
A	EP 0782352 A2 (AT&T CORP.), 2 July 1997 (02.07.97), column 2, line 20 - column 5, line 26	1-19
A	WO 9514355 A1 (LIAONING GONGHE ELECTRONIC CO., LTD.), 26 May 1995 (26.05.95), abstract	1-19

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents	"I" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A" document defining the general state of the art which is not considered to be of particular relevance	"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
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Date of the actual completion of the international search	Date of mailing of the international search report
28 October 1999	29 -10- 1999
Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer  Stefan Hansson/MN Telephone No. +46 8 782 25 00

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## METHOD FOR ESTABLISHING A SIGNALING CONNECTION WITH A MOBILE STATION

The invention relates to a method defined in the preamble of claim 1 for establishing a signaling connection with a mobile station. The method is applicable e.g. to third-generation mobile communications networks such as the UMTS (Universal Mobile Telecommunication System), for example.

Fig. 1 illustrates the basic digital mobile communications system architecture. Typically, a mobile communications network comprises at least one core network CN and one or more radio access networks RAN. A core network CN comprises mobile switching centers MSC and possibly other service nodes. A "node" is here a generic name for network components that take part in the switching; thus it also covers mobile switching centers and other exchange equipment. The radio access networks are located between the core network and the terminal equipment. A radio access network comprises base transceiver stations BTS and a radio network controller RNC. Each base transceiver station BTS is connected in a fixed manner with the radio network controller RNC of the radio access network in question. Each radio network controller is in turn connected in a fixed manner with at least one core network node.

The general principle of paging in digital mobile communications networks is according to Fig. 2 as follows. When a call has arrived in a mobile switching center MSC in the traffic area in which the called subscriber is located at that moment, the switching center sends a paging request via radio network controllers to those base transceiver stations in whose area the register data indicate the called subscriber is. The base transceiver stations send the paging message to the radio path on their paging channels PCH. A mobile station that detects its own subscriber identity on a paging channel which it monitors, sends a response to the base transceiver station. This way the network will know the location of the called subscriber with an accuracy of one cell, and the data connection can be established. In this description and in the claims attached hereto, "data connection" refers to a connection established for the transmitted signal proper. Usually, the most common type of data connection is a voice connection.

In third-generation mobile communications networks, a mobile station may have several international mobile subscriber identities IMSI, and may also have multiple simultaneous data connections under different subscriber identities. If a mobile sta-

Advantageously, when the mobile station's data connection(s) is/are terminated, the data associated with the mobile station are kept in the paging database for at least a certain predetermined period of time after the termination of the connection(s).

- 5 An advantage of the invention is that the paging channel load in the cells is reduced since no paging process is needed for the incoming calls, at least not if a data connection already exists at the mobile station. From the mobile station's point of view this means that during a data connection it does not have to listen to the paging channels. Another advantage of the invention is that when a mobile station is called
- 10 that has no data connections but has information about it in the database according to the invention, it possibly suffices to send the paging message to one paging channel only. From the point of view of the mobile station this means that it only needs to listen to one paging channel. Yet another advantage of the invention is that connections from different core networks to one and the same radio access network will
- 15 become practical. This is due to the fact that if a subscriber identity associated with a call coming from an "outside" core network is found in the database according to the invention, the information associated with the identity can be used to direct the paging. For such calls, a mobile station only needs to listen to one paging channel, and not even that in the best case. A further advantage of the invention is that when
- 20 the general packet radio service GPRS is used, there is no need to transfer subscriber identity information between the mobile switching center MSC and the serving GPRS support node SGSN. A yet further advantage of the invention is that the setting up of simultaneous connections of a mobile station becomes quicker.
- 25 The invention is below described in detail. Reference is made to the accompanying drawing in which

- Fig. 1 shows an example of a network architecture in which the invention is applicable,
- 30 Fig. 2 illustrates signaling in the paging according to the prior art,
- Fig. 3 shows an example of signaling according to a preferred embodiment of the invention,
- Fig. 4 shows by way of example a block diagram illustrating the operation according to a preferred embodiment of the invention,
- 35 Fig. 5 shows in the form of block diagram a second example of the operation according to a preferred embodiment of the invention,
- Fig. 6 shows an example of the transfer of subscriber identity information ac-

radio access network or networks in the area of which the register data indicate the mobile station MS is located. On the basis of the paging request each controller RNC sends a PAGING message to the base transceiver stations BTS of its area, and each base transceiver station sends a paging message to the radio path on at least one paging channel PCH. Each active mobile station listens to at least one paging channel. Said mobile station MS detects in the paging message its own subscriber identity IMSI2 and sends a RESPONSE message to a base transceiver station in the cell in which it is located. This, in turn, sends a response message to the respective radio network controller RNC which then sends a response message to the switching center MSC. The response message includes information indicative of the cell in which the mobile station MS is located, on the basis of which the MSC sends to the appropriate radio network controller RNC a CONNECT REQUEST for a new data connection. Said controller sends to the appropriate base transceiver station BTS the necessary instructions in a CONNECT message. Fig. 2 does not show the steps associated with the setting up of the data connection proper.

Fig. 3 shows in the form of timing diagram an example, corresponding to the one shown in Fig. 2, of the operation according to a preferred embodiment of the invention. The initial stages of the operation from the call up to the moment when the paging request is sent to at least one radio network controller RNC are identical with the example of Fig. 2. In this example, the database 101 according to the invention is established in at least one radio network controller RNC. Moreover, in this example, the mobile station MS to which the CALL is targeted at has at the moment of the call a data connection under subscriber identity IMSI1. Because of this earlier connection the database 101 contains information about the location of the mobile station with the accuracy of one cell. As the controller RNC receives a paging request for IMSI2, it checks 301 the paging database 101. As a result of that check, it finds information about the location of the mobile station identified as IMSI2. Therefore, the controller RNC immediately sends a RESPONSE message to the switching center MSC. The paging process proper may thus be skipped. When the switching center has received the response message, the operation continues as in the example of Fig. 2.

Fig. 4 shows in the form of block diagram an example according to a preferred embodiment of the invention of the use of the paging database 101 in the network of Fig. 1. In block 401, power is switched on at a mobile station MS, which has been assigned at least a first subscriber identity IMSI1 and a second subscriber identity IMSI2, whereby the mobile station enters the active mode. In block 402 a call is

transceiver station to signal with, so that the new connection can be established without the paging process. In addition, information about the signaling connection associated with the first data connection is also fetched from the database 101, which information is then used in setting up the new data connection (block 412). After  
5 that, the fast paging described above may be repeated even if the first data connection were released, as long as there exists a connection.

Fig. 5 shows in the form of block diagram a second example of the use of a paging database 101 according to a preferred embodiment of the invention in the network  
10 of Fig. 1. The example illustrates the paging of a mobile station MS the data connections of which have terminated but which is still in active mode. In block 501, the last data connection, under subscriber identity IMSI1, is released. After that, the mobile station is in standby mode. Here and in the claims, the standby mode of a mobile station refers to the mode in which the mobile station is in after the termina-  
15 tion of a data connection or data connections and in which the mobile station is ready to receive new calls. During the standby mode the network monitors the location of the mobile station (block 502) with an accuracy of a location area LA, which comprises a plurality of cells. If necessary, contactability information of the mobile station MS is updated in the paging database 101, as shown in block 503. In block  
20 504 it is checked whether a call for the mobile station has arrived in a core network node. If no call arrives in a predetermined time and no connection is initiated by the mobile station, the paging database will be discontinued for the mobile station in question. This time-out monitoring is not shown in Fig. 5. If a new call arrives, the core network node in question sends in the normal manner a paging request to radio  
25 network controller RNC1, as shown in block 505. The call may be associated with any subscriber identity used by the mobile station MS. In block 506, the software in controller RNC1 retrieves the information relating to identity IMSI1 from the paging database. In block 507 it is checked whether the location information has changed after the release of the last data connection. If it is found that the mobile station MS is located in a location area LA different than the one where it was when the previ-  
30 ous data connection was terminated, a paging process is started in the area in question (block 509). If it is found that the mobile station MS is in the same location area as where it was when the previous data connection was terminated, a paging message is sent to the cell indicated by the location information associated with  
35 identity IMSI1 (block 508). This is done because the mobile station MS is then probably in the same cell as where it was when the previous data connection was terminated. If, however, it does not respond, a more extensive paging process has to be



## Claims

1. A method for establishing a signaling connection with a mobile station in a network that comprises at least one radio access network (RAN) and at least one core network (CN), in which method at least some of the mobile stations are assigned at least two subscriber identities, characterized in that the method comprises steps in which
  - a paging database (101) is created of subscriber identities of mobile stations active in a traffic area of the node that includes said paging database,
  - said subscriber identities are supplemented with contactability information for the corresponding mobile stations,
  - said subscriber identity and contactability information are used to establish signaling connections with active mobile stations located in said traffic area, and
  - said contactability information is updated in accordance with contactability changes detected.
2. The method of claim 1, characterized in that the paging database (101) is located in a radio access network (RAN).
3. The method of claim 1, characterized in that the paging database (101) is located in a core network (CN).
4. The method of claim 1, characterized in that said contactability information comprises location information concerning said mobile stations.
5. The method of claim 1, characterized in that said contactability information comprises information about the signaling connections associated with the data connections of said mobile stations.
6. The method of claim 1, characterized in that said contactability information comprises information about the primary paging channels listened to by said mobile stations.
7. The method of claim 1, in which a mobile station (MS) uses a first and a second subscriber identity (IMSI1, IMSI2) and said mobile station (MS) has a first data connection via a first radio access network (RAN1) established under the first subscriber identity (IMSI1) and a call for said mobile station (MS), associated with the second subscriber identity (IMSI2), arrives in a node of a core network connected with the first radio access network, characterized in that the signaling required by said call uses the same signaling connection as is used in the signaling of the first

for RRC-layer messages belongs to the SRB channels.

15. The method of claim 13, **characterized** in that said RRC-layer message is a message defined specifically for the transfer of subscriber identity information.

16. The method of claim 13, in which said mobile station receives during the establishment of a data connection a paging message and sends a response message for the paging message, **characterized** in that said subscriber identity information is included in said response message for the paging message.

17. The method of claim 13, **characterized** in that said subscriber identity information is included in a message indicating parameter values for the mobile station.

10 18. The method of claim 1, where a mobile station has a data connection under a first subscriber identity, **characterized** in that the contactability information associated with the first subscriber identity is updated when said mobile station moves from one cell to another.

15 19. The method of claim 1, where a mobile station in standby mode has had a data connection under a first subscriber identity, **characterized** in that the contactability information associated with the first subscriber identity is updated when said mobile station moves from a location area (LA) to another location area.



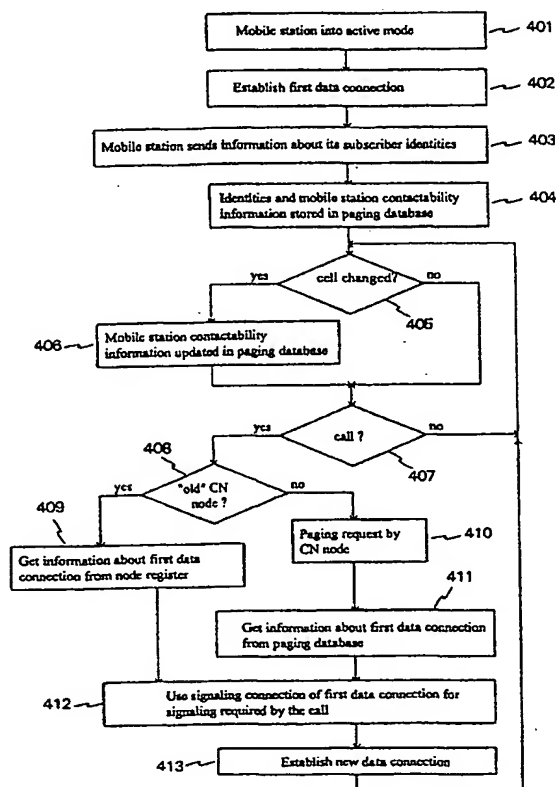
## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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			(43) International Publication Date: 14 October 1999 (14.10.99)
(21) International Application Number: PCT/FI99/00276 (22) International Filing Date: 1 April 1999 (01.04.99) (30) Priority Data: 980783 3 April 1998 (03.04.98) FI (71) Applicant (for all designated States except US): NOKIA TELECOMMUNICATIONS OY [FI/FI]; P.O. Box 300, FIN-00045 Nokia Group (FI). (72) Inventors; and (75) Inventors/Applicants (for US only): AHMAVAARA, Kalle [FI/FI]; Ruostekuja 3 D 24, FIN-01610 Vantaa (FI). VIALEN, Jukka [FI/FI]; Tyrskykuja 3 b 13, FIN-02320 Espoo (FI). (74) Agent: BERGGREN OY AB; P.O. Box 16, FIN-00101 Helsinki (FI).		(81) Designated States: AE, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZA, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).  Published <i>With international search report.</i> <i>Before the expiration of the time limit for amending the claims</i> <i>and to be republished in the event of the receipt of amendments.</i>	
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(54) Title: METHOD FOR ESTABLISHING A SIGNALING CONNECTION WITH A MOBILE STATION

## (57) Abstract

The invention comprises a method for establishing a signaling connection with a mobile station, which method is particularly applicable to third-generation mobile communications networks. A database is created at a node of a mobile communications network, and a mobile station connected with the network sends to said database information about all its subscriber identities (403). In the database, information is added (404) to the subscriber identity information which may be useful when said mobile station is paged (410, 411). Such contactability information includes e.g. the mobile station's location information, information about existing signaling connections and information about the primary paging channel monitored by the mobile station. The contactability information is updated according to changes detected in the status of the mobile station (406). The database will be discontinued for a mobile station that has had no connections for a predetermined time. The method reduces paging channel load in cells, reduces the need of mobile stations to listen to paging channels and makes radio access networks connections to multiple core networks more practical.



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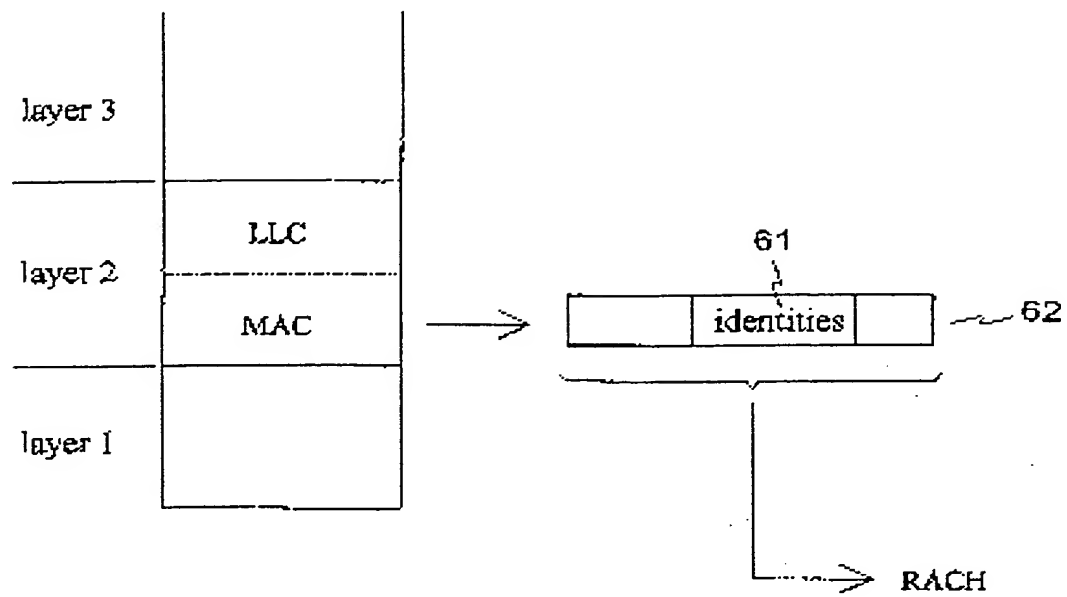


Fig. 6

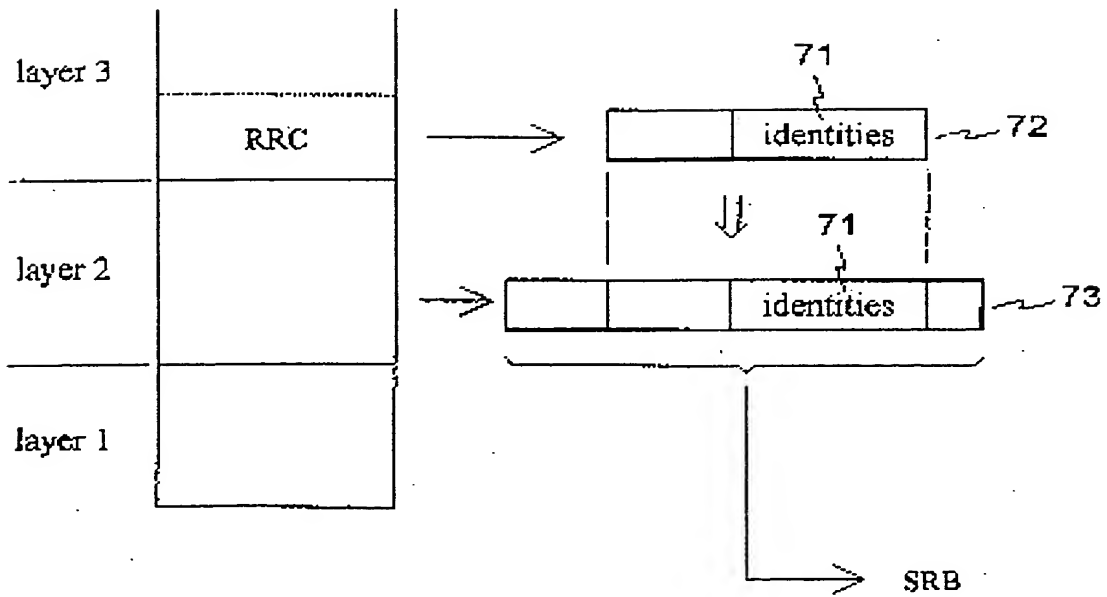


Fig. 7



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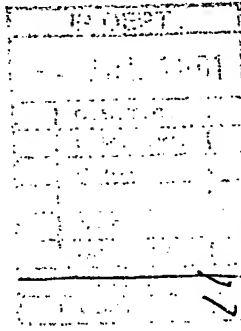
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Anmeldung Nr./Application No./Demande n°/Patent Nr./Patent No./Brevet n°.  
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Anmelder/Applicant/Demandeur/Patentinhaber/Proprietor/Titulaire  
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## COMMUNICATION

The European Patent Office herewith transmits as an enclosure the European search report for the above-mentioned European patent application.

If applicable, copies of the documents cited in the European search report are attached.

☐ Additional set(s) of copies of the documents cited in the European search report is (are) enclosed as well.

The following specifications given by the applicant have been approved by the Search Division:

☒ abstract

☒ title

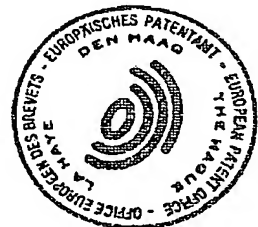
☐ The abstract was modified by the Search Division and the definitive text is attached to this communication.

The following figure will be published together with the abstract:

2

## REFUND OF THE SEARCH FEE

If applicable under Article 10 Rules relating to fees, a separate communication from the Receiving Section on the refund of the search fee will be sent later.





DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
D, A	"Universal Mobile Telecommunications System (UMTS); RRC Protocol Specification" 3GPP TS 25.331 VERSION 3.5.0 RELEASE 1999, 1 December 2000 (2000-12-01), XP002168551 * page 30 - page 32 * * page 615 - page 622 * -----	1-3	H04Q7/32
A	WO 99 52317 A (NOKIA TELECOMMUNICATIONS OY ;AHMAVAARA KALLE (FI); VIALEN JUKKA (F) 14 October 1999 (1999-10-14) * abstract * * page 5, line 34 - page 8, line 2 * * figures 1,4,5 * -----	1	
The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (Int.Cl.7)
			H04Q
Place of search MUNICH		Date of completion of the search 30 May 2001	Examiner Rabe, M
CATEGORY OF CITED DOCUMENTS			
X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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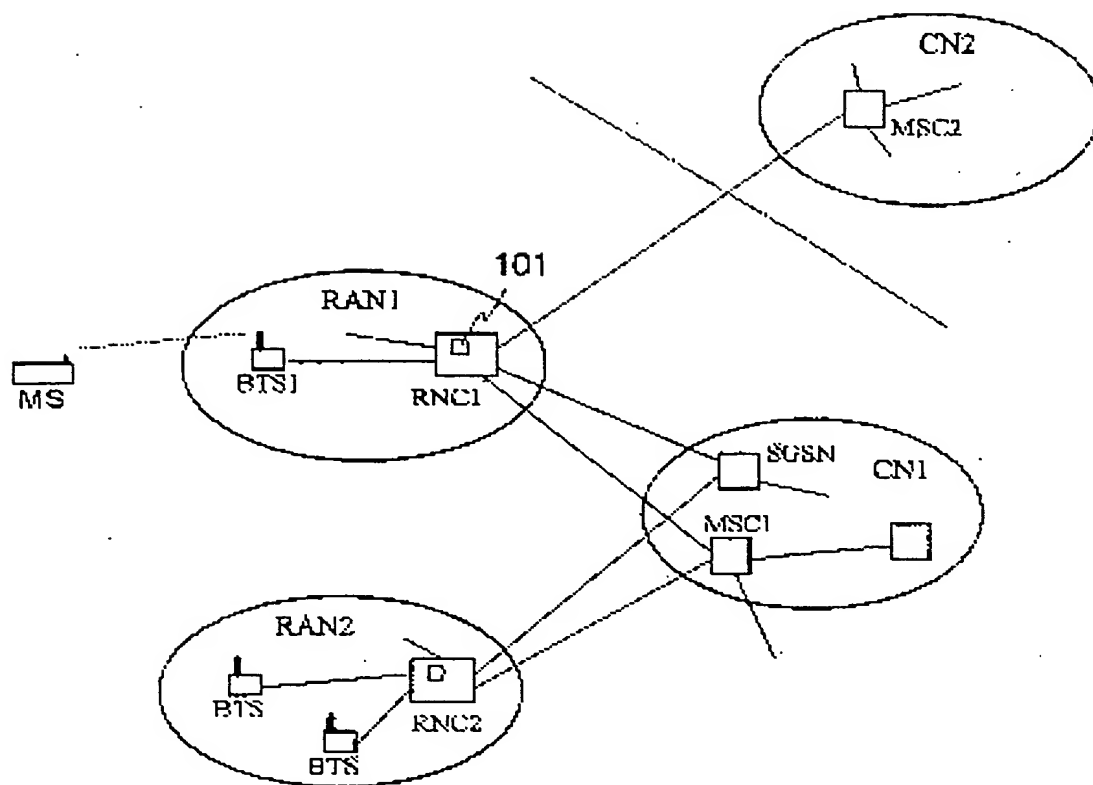


Fig. 1

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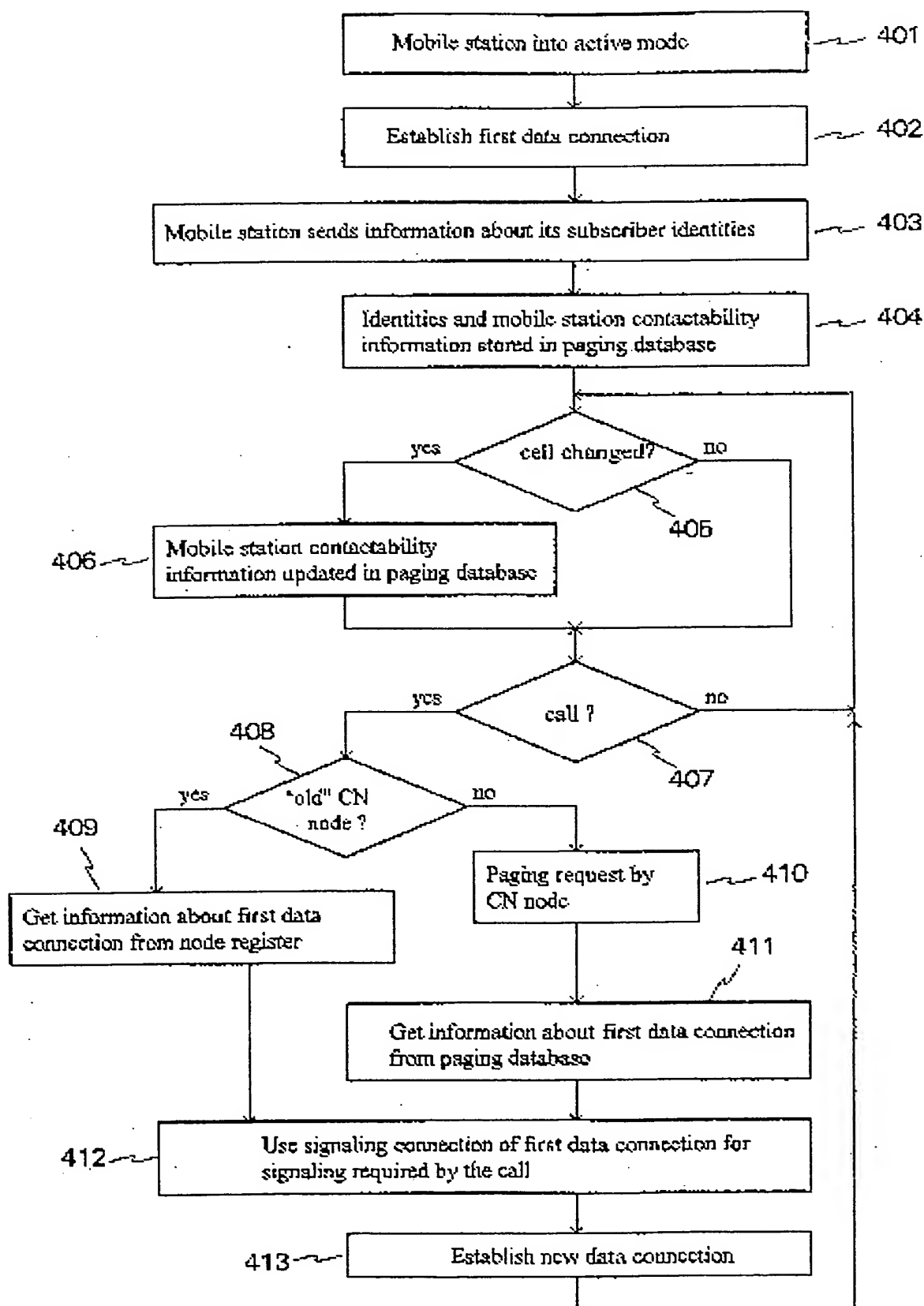


Fig. 4



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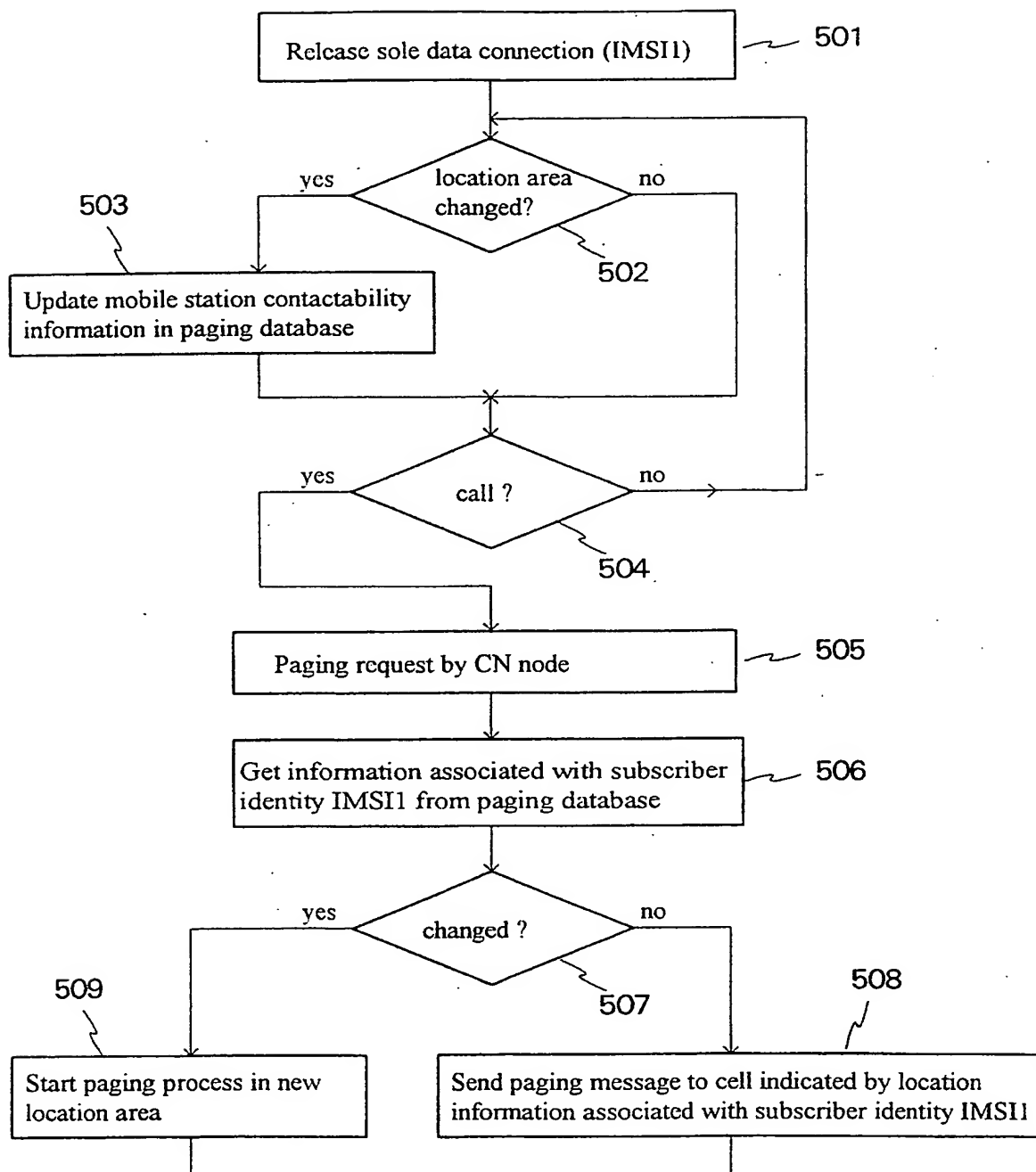


Fig. 5

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